IMPLEMENTATION OF SIX –SIGMA IN ACADEMIC LIBRARIES FOR INCREASING SERVICE QUALITY

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ABSTRACT

This paper provides justification of six sigma implementation for academic libraries. The purpose of any academic library is to satisfy to all its users according to their need and demand. Users are the back bone of the library and they are the best judges to evaluate the service quality of the library. But in general it is difficult to satisfy every user. To evaluate "users' satisfaction" and to develop the "quality" of the academic library, it is compulsory to bring a new innovation. To develop the service quality of the academic library and to provide maximum users' satisfaction, it is necessary to implement Six Sigma in academic libraries. This paper helps to apply scientific and systematic upgrading strategy to have a better service quality to meet the needs of the users and also helps to find out the solutions for complaints and problems. Emphasis is given to application issues such as what are the methods of the six sigma tool to be implemented for providing better service to the users. The aim of this paper is to help widen the scope of six sigma implementation in Academic Library Management. This paper also covers some case studies to understand the effect of six- sigma after its implementation.

KEYWORDS: Six Sigma, Library Measurement Tool, Library Quality Management, Academic Library, Six- Sigma, Users' need, Users' Demand, Users' Satisfaction

INTRODUCTION

Six-sigma is a methodology and set of tools used to improve quality. Six -sigma was first used in 1980 in the manufacturing sector. The theory of Six Sigma has been implementing in manufacturing sectors to eliminate wastages and users' complaint to satisfy the clients. Later it is being applied in service sector to get the benefits of six- sigma. Six-sigma is a quality improvement tool to measure the process outputs for error reducing system. It aims to maximize user/customer satisfaction and minimize defects in products and services being offered by an organization. Six-Sigma is now increasingly being applied to a wide range in the application of library services. Six- Sigma is now being applied in library management activities like Acquisition, Classification & cataloguing, Inter library loan, etc. To provide maximum users' satisfaction, it is necessary to implement Six Sigma in Libraries. This tool is also helpful for improving the quality of the library service. Six -Sigma helps the library to satisfy the library users in an effective and better way. It uses a set of quality management and statistical methods to get the maximum users' satisfaction. So six -sigma is a tool used for assessing the quality and problem solving. In such a way Six Sigma can be applied in library field to maximize the users' satisfaction by eliminating their complaints and problems.

OBJECTIVES OF THE STUDY

The prime objectives of this paper is:

- To spread awareness among the library professionals about the concept of six- sigma and its right application in field of library service.

- To make the library professionals aware about achieving the maximum satisfaction of the user through enhancing quality of the library services by implementing methodologies of six- sigma.

- To make the library professionals aware of the fact that library is going to be a full-fledged service oriented profession.

- To seek implementation of Six Sigma as a result of well-organized management.

- To launch information resources and quality service in the competitive world to improve the satisfaction of users.

DEFINITION

Six- Sigma is a concept which is the combination of two words, i.e. 'Six' and 'Sigma'. Sigma (ϭ) is a Greek letter used in statistics and mathematics to define standard deviation. The Sigma scale of measurement points out defects per unit or probability of a failure. According to statistics, Sigma (σ) denotes the standard deviation of a process. In a nutshell, sigma is the symbol and six is the scale of measurement. A process may have one sigma, two sigma, etc. In this way six- sigma indicates higher quality of product or service. In Six Sigma, a defect means anything that does not satisfy user. Actually, Six Sigma is a quality improvement method to eliminate defect in any process up to near perfection, to be more quantitatively, a six sigma process must not produce more than 3.4 DPMO (Defects per Million Opportunities). It is statistically based methodology for improving product quality to meet the users' needs.

The U. K. Department of Trade and **Industry**[1] defined Six-sigma as "A data driven method for achieving near perfect quality. Six-sigma analysis can focus on any element of production or service and has a strong emphasis on statistical analysis in design, manufacturing and customer oriented activities", (June 2005).

In the term "Six Sigma", Bob Galvin of Motorola, Larry Bossidy of Allied Signal and Jack Welch of General Electric developed a framework to make Six sigma happen."Six-sigma in **Motorola**[2] is considered at three different levels:

- As a Metric

- As a Methodology

- As a Management System.

Essentially Six-sigma is All Three at the Same Time".

Six Sigma Academy (**Ramasamy, 2009**)[3] defines it as "a business process that allows organizations to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste".

Antony (2004)[4] defines it as "a strategy that seeks to improve the quality of processes through identifying and removing the causes of defects by focusing on outputs that are critical to customers".

Kumar[5] stated that six sigma is a statistical measurement, which provides the opportunity and discipline to eliminate mistakes, improve morale, and save money. Doing things rightly and keeping them consistent are the basic ideas behind six- sigma.

According to **Harry**[6], CEO of Six Sigma Academy, Phoenix, USA:

Six-sigma is a well-structured, disciplined, data-driven methodology for eliminating defects, waste, or quality control problems of all kinds in manufacturing, service delivery, management, and other business activities. It is a business strategy that allows companies to drastically improve their performance by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction.

From the above definitions the following points are to be noted:

- It is a data driven method based on statistical analysis.

- It is a method for achieving near perfect quality/Quality management in production and services.

- It is an improvement of operational performance by minimizing the root causes of defects.

- It is user/customer centred.

- It is implemented for user satisfaction.

REVIEW OF LITERATURE

Both Indian and foreign literature have been surveyed thoroughly. From that literature the following literatures are noteworthy.

Burns(2006)[7] in "Six Sigma" made an important question about the process of six sigma as it is a specification oriented methodology in which defects are controlled or eliminated and specifications are set as per the needs or requirements of the customer and not the processes.

Susan Kumi and Johan Morrow (2006)[8] implemented the six sigma tool to improve self services at New Castle University Library. They also suggested the defects in self service at the above mentioned library.

Kim(2006)[9] in his work "A study on introducing six sigma theory in the library for service competitiveness enhancement" preached that the application of six sigma is a solution for efficient and effective knowledge management and better user satisfaction but only a theoretical framework has been provided and no real life solutions have been suggested or illustrated.

Kaushik, et.al (2007)[10] in their paper "Six sigma applications for library services" presented that six sigma applications are still not in used to enhance library services and they have showed a number of critical points regarding qualification and key performance indicators. In their pilot study they have suggested that a tailored six sigma can be implemented for better library services.

Sarah Anne Murphy (2009)[11] implemented in Ohio State University Library to analyze virtual reference services and recorded the benefits and limitations of deploying a lean six sigma with a library organization.

Yong Kim, et al (2010)[12] applied six sigma in acquisition process of a library and it showed that services of the library acquisition was good and better after implementing six sigma tool.

Ahmad Ali Al-Zubi and Basha (2010)[13] implemented Six Sigma in Library Management for quality control. The authors have suggested plan-do-check and act methodology as a part of six-sigma.

Dong – Sug Kim (2010)[14] implemented Six Sigma in Sungkyunwan University Library and determined its success factors. He also states the advantages and disadvantages of six-sigma in university libraries.

Pardeep Rattan & Dr. Pyare Lal (2012)[15] studied about the pros and cons of six sigma for renovating library and information services. They make an attempt to critically evaluate the relevance of six sigma statistical thinking with a focus on library and information services.

FEATURES OF SIX SIGMA TOOL

- It follows DMAIC frame work.

- It advocates "Top – down" approach.

- It is user's satisfaction oriented.

- It imparts elaborate training and certification process that result in Black Belt, Green belt, and so on.

KEY CONCEPTS OF SIX SIGMA

In general Six- sigma Six- sigma revolves around a few key concepts such as Critical to Quality, Defects, Process capability, and Stable Operations. The academic library should define the actual needs of the library users' by focusing on their demands, and then the library should measure, analyze, and control over it. These concepts help to keep close contact with customers to know their needs, demands and complaints. The concepts below guide the library to meet users' needs in an easiest way.

- **Critical to Quality:** Attributes most important to users to know their needs.

- **Defects:** Failing to deliver what the user wants, so it is helpful to overcome the failure of library services by minimizing the defects. After minimization of defects, the library can satisfy automatically the user's need.

- **Process Capability**: What your process can deliver i.e. to know the capability and capacity to process the delivery to improve the procedural quality of library services.

- **Stable Operations:** Ensuring consistent, predictable processes to improve what the customer sees and feels.

NEED OF SIX-SIGMA IN AN ACADEMIC LIBRARY

At present academic libraries are influenced by information communication technology. So academic libraries must satisfy user's need as well as meet their expectation. Moreover, academic libraries should constantly provide quality services to users by minimizing the costs. Six -sigma is a method for improving quality by reducing errors that result in quality service with reducing costs. Using six-sigma in academic libraries can improve their service to users by reducing defects and minimizing cost involved in library services. This will satisfy users as well as the funding organization.

ADVANTAGES OF SIX SIGMA TOOL

- Six- sigma helps to minimize the effort and maximize the users' satisfaction.

- Six- Sigma helps to understand and manage users' needs.

- It lines up the key process to achieve the needed requirements of the users.

- It exploits the accuracy in data analysis to minimize defects in the process.

- It brings fast development and continuous improvement to management process.

- It helps to work smart rather than hard.

- It brings the efficiency among employees.

- It reduces process cycle time, thus reduces costs.

- It provides better decision making capacity.

- It provides better understanding of processes.

DISADVANTAGES OF SIX SIGMA TOOL

- The quality standards in six sigma should be according to specific task and measuring 3.4 defects per million as standard that leads to more time spent in areas which are less profitable.

- Six-Sigma gives stresses on the rigidity of the process which is opposite to the innovation and kills the creativity.

- Six- Sigma is a continuous improvement techniques and tool. As a result of which it promotes outsourcing of improvement projects with lack of accountability.

- Implementation of Six Sigma constantly requires skilled man power which is not available at large.

- There are a lot of real time barriers which should be resolved while changing the theoretical concepts into practical applications.

METHODOLOGIES OF SIX SIGMA TOOL IN AN ACADEMIC LIBRARY

Six sigma methodologies is a highly controlled management approach that promises the academic libraries to provide their best services to achieve higher profits by increasing satisfied customers.

There are mainly two types of methodologies in Six Sigma -- DMAIC and DMADV or DFSS. But another method is PDCA.

DMAIC

Library is a place where knowledge is discovered. Driven by this philosophy DMAIC methodology is used in an academic library. DMAIC stands for Define, Measure, Analyze, Improve and Control. DMAIC is used to improve an existing library system. DMAIC cycle method should be repeated again and again for continuous improvement for library service. DMAIC is the best method for the library environment. The method emphasizes on continuous assessment, improvement, and guide to bring out excellent services to library users. There are five stages in DMAIC methodology to improve the quality, service, and resources of the library. First importance is given to "Define" the problems, the opportunity, the process, the projects, the goals and the users. With reference to academic library, "Define" may involve the identification of target group of library users and the attributes of their age, gender, qualifications or present area of interest and their information needs. The goals can be the kind of services to be provided, method of providing those services, training to users, users' survey, availability of infrastructure for the utilization of information sources etc.

The second one is "Measure", which helps the industry or organization to decide current level, current process and decide users' needs and requirements. With respect to academic library, "Measure" mainly involves the making out of number of users and kind of collection in any library. Data can also be of information use, behavior of the library users, how and from where the information is gathered and what ways are adopted to process it so as to make that information accessible. What are the different formats of information available and what storage media is used for information products are other dimensions of measurement.

"Analyze" is the step which guides the industry or organization to decide the origin and source of the defects. In the context of the academic library "Analyze" includes origin/source of the problems and elimination of distance between users & library staff, library users demands in a systematic way. This step also suggests the establishment of what resources are more exploited or are more in demand and why. What are the reasons for under utilization of other information sources and services? Feedback can be taken about present academic library set up and regarding what new services should be introduced or how the status of existing library products and services can be enhanced in terms of collection, timings, staff etc.

The fourth step "Improve" stresses to improve the process by eliminating defects or performance or current procedure or standard of work. In the context of the academic library, "Improve" involves the discovery of new ideas, plans, quality, current process and performance by reducing and removing the defects, smart work orientation of users towards the library services and resources. User education for improvement through seminars, exhibitions, lectures, library portal, and library website are the best options. User friendly library management software may be installed and for providing better library services periodic training programmes for library staff and users should also be conducted.

At last the step is "Control", which makes the industry or organization to look and take control all the above acts. With reference to academic library, "Control" denotes to tackle the forthcoming threat or danger. This step controls and eliminates the users' complaints and overall control of the above acts. The role of top management in compilation and implementation of above phases, especially the feedbacks form library users and people within the organization are necessitated under control. The change in policies for improvements, budgetary provisions and involving librarian in policy decisions are some of the dimensions of control mechanism.

DAMDV

DMADV aims to create those products and services that best suits and match the customer needs. It is also called DFSS- Design for Six-Sigma.

Define: This phase of six-sigma identifies, determines and sets the organizations' goals according to the users' needs. This phase is almost the same as DMAIC.

Measure: At this stage the organization i.e. an academic library identifies and measures those factors that are critical to quality, exactly determines the customer needs and specifications, product capabilities and risk factors.

Analyze: Alternative processes are designed and analyzed to meet users' needs along with the existing processes. The library six- sigma team should place various design options and right options are to be chosen after evaluation.

Design: The best design or model implied from above phases is selected and customized for the academic library. In this step pilot plan can be chalked out.

Verify: Performance and ability of the selected design to meet users' need is verified in this phase. All the processes are required to be documented and process can be transferred to regular process.

From the academic library perspective the library user is fundamentally important. Users' feedback and user awareness about the library products and services should be given utmost importance. The aforementioned point should be kept into mind, while formulating academic library objectives and designing academic library services.

PDCA

PDCA **Plan** – **Do** – **Check** – **Act** cycle is used for the better quality control. PDCA is helpful for the overall strategic planning, needs-analysis, library goal-setting and library instructions and evaluation, curriculum design and collection development, provision for development and enhancement of users' services and their needs. PDCA has four phases--

Plan: Set up the goals and objectives for the improvement of the library. Planning will be done based on users' needs and satisfaction. Here the output is users' satisfaction. In short planning means the design of a new academic library plan and redesign of the old plan.

Do: Implement the processes to reach the expected standard result. Implementation of the planning of the library and decide when, how and where the plan will be executed for increasing the service quality.

Check: This step is utmost important as it studies the above two steps. Analyze the existing one and create a new one to suit the betterment for the library users. Check the activities so far the libraries have done and ensure the output to give the best services of the library.

Act: The last step is act. Decide and move Plan-Do-Check into action. Analyze, determine and implement the changes to bring the betterment to improve the library services.

Implementation of Six Sigma in an Academic Library

An academic library has to go through six phases before the implementation of six-sigma. Phases one to four are meant for the establishment of six sigma, and phases five and six are meant for realization of six- sigma.

The first phase is to set up the commitment within management and library staff towards implementation of six-sigma. This phase needs training to the senior library staff about principles and tools of six-sigma and development of management infrastructure to implement six- sigma.

The second phase concerns with collecting of information. This could be observed through communication with users, vendors and library staff. For example, information regarding the acquisition and issue may be collected from users and suppliers. Analysis of the information helps to identify the hindrances in these processes.

The third phase of six-sigma deals with the training of the library staff. Training from the librarian to the library clerk is mandatory. Black belt and Green belt are the levels of training. Black Belt training is meant for top management and Green Belt training is mainly for the members of the staff engaged in the project. An experts' opinion may be another option.

The fourth phase of six-sigma is the implementation for developing a monitoring system. First three phases construct a framework of the management and development of monitoring system that will complete in the fourth phase.

Adequate internal or external measures e.g, user satisfaction survey, balance score card, etc. should be created for strategic goals and key processes.

The application of six -sigma begins from phase five where library processes are to be improved. Current processes are mapped and problems within these are identified.

At the last phase six sigma projects are to be conducted.

Method of Calculation of Levels of Sigma for Academic Library

To calculate the levels of sigma, the following six sigma conversion table is needed.

Table 1

Sigma	Quality in %	Defects Per Million Opportunities(D P M O)
6 Sigma	99.999999 8	3.4
5 Sigma	99.999943	233
4 Sigma	99.9937	6210
3 Sigma	99.73	66807
2 Sigma	69.1	308537
1 Sigma	30.1	691462

The following is an example of six sigma calculation for any process regarding the academic library. Suppose the process of book issue in a closed access automated academic library takes five steps and sigma level of this process may be calculated in the following way:

Total steps taken= 05

Suppose, the chances of defects in each step=02

So the total defect opportunity is 5 x 2 = 10

If 3 issued out the books out of 100 take more time than its usual time or it may be defective.

Then defects per issue 3/100 = 0.03

So, Defects Per Opportunity (DPO) = 3/ (10 x 100) =0.003

So, Defects Per Million Opportunities (DPMO) = 0.003 x1000000 =3000

Thus the Sigma Level of this book issuing process is 4.25 ó

CASE STUDIES OF SIX SIGMA

Newcastle University Library, Newcastle, UK

Six-sigma was implemented for a period of six months at Newcastle University Library, UK to improve the self-service at the library. Pre-implementation statistics showed that satisfaction rating for self-service were high, i.e. 89.6% among students and 72% among staff, but total rate of self-issue was quite lower, i.e. 35% of total circulation. After the implementation of six -sigma the observed results were--reduction of staff at circulation desk, moving the self-issue units to more appropriate location, encouraging self-issue by increasing the loan period for self-issue, allocation of more time in user training of self-issue system, maximum resources of the library made self-issuable, i.e. CD ROMs. **Susan Kumi and John Morrow (2006)**[8] observed the defects in self-service at Newcastle University Library.

University of Arizona Library, Arizona, US

In **University of Arizona Library**[16], Six- sigma was being implemented as a seven month project done by Jeanne F. Voyles, Linda Dols, and Ellen Knight in 2009 to improve the Document Delivery Service (DDS) which includes ILL (Interlibrary loan), scanning, printing, and photocopying services. It is a case study of DMAIC implementation process. During the application only they could identify the problems in the process of DDS such as turnaround time for requested articles to 70%, inappropriate staffing, etc. On the basis of their research they concluded six sigma as, "a data based analysis of current processes, identification of the gaps in service expectations and actually delivery of service, and a team approach to discovering and designing process improvements can ensure that the libraries "know what they are doing."

Sungkyunkwan University, Seoul, South Korea

A detailed case study was done by **Dong-Sug Kim**[14] in 2010 on the advantages and disadvantages of Six Sigma implementation in Sungkyunkwan University. Sungkyunkwan University had applied 'six-sigma' in its every department including the library. Researcher pointed out some constructive opinion of six sigma implementation, i.e. making work method scientific, increasing process capacity, etc. while the negative opinions include lack of time of participation, lack of interest in employees, poor standardization, and difficulty with defining work process. The researcher opined that there are many advantages to implement the six -sigma in a library.

Jayakar Library, University of Pune, India

The study of six sigma implementation in Jayakar library of Pune University was observed by **Ujvala Sudhir Ulhe and S.K. Patil**[17] (2011). Six-sigma, implemented in 2007, applied in every section of library. They pointed out the defects in three groups i.e. in context of quality, in context of management, and in context of other departments. After identification of defects or errors they started to rectify phase wise errors for improvement of quality service of the library and rectified more than 25 defects out of 86 defects. Though they could not achieve the level of 3.4 DPM but improved well. The process is still going on to achieve the expectation level.

APPLICATION AREAS OF SIX- SIGMA TOOL IN ACADEMIC LIBRARY

The possible areas in which the Six Sigma tool may be applied are as follows:

- Acquisition
- Classification & Cataloguing.
- Circulation
- Stack Maintenance
- Inter Library Loan
- Reference service

HIERARCHY STRUCTURE OF SIX- SIGMA IN ACADEMIC LIBRARY

As far as the Six Sigma tool is concerned, library staff should be trained on the fundamental and practical knowledge of sigma. Starting from Chief librarian to lower level library attendants are to be trained. Many management institutions offer training and give certification with belts for ranking the hierarchy. There are four types of belts in six

sigma viz- Master Black belt, Black Belt, Green belt and White belt. As for an example in a college library, Head of the institution i.e. Principal is the Champion, Chief Librarian is the master black belt, Assistant Librarian is Black belt, Library Assistants are Green belt, and Library attendant is white Belt. Role and duty are assigned according to the hierarchy.

IMPACT OF SIX- SIGMA IN ACADEMIC LIBRARY

- It helps to achieve users' needs and demands and continuous efforts will reduce process variation.

- Six- Sigma helps to achieve short-term rather than long term performance.

- It helps to minimize library employees work effort and maximize the users' needs.

- It helps to achieve users' satisfaction and to improve the quality of the library.

- Six Sigma guides the employee to work smart rather than work hard.

LIMITATIONS OF THE APPLICATION OF SIX SIGMA IN ACADEMIC LIBRARIES

Six-sigma has many advantages but it has its limitations. The limitations are as follows:

- It is not possible to collect data accurately. The data collection largely depends upon the willingness of the user and on availability of data.

- It sounds improper as far as libraries are concerned because defects may be anything that does not suit or match users' demands and needs.

- Due to the advancements in technology, users' needs and demands are different from time to time. The critical total quality of today may not be applicable in true sense tomorrow.

- There is neither any specific tool nor any provision for any pin pointed procedures to achieve the set goals.

- There is a lack of linkage between six sigma and organizational work culture. Six-sigma needs to be separated because the organizational culture is different for different setups.

- It is merely a specification driven methodology. Defects are controlled with the change in specification and these specifications are again changed as per customer needs and behavior.

- It has lack of originality because six sigma measures standard deviation from the standards/ specifications set to achieve quality with regard to products and services.

- It is the basis of human nature and perception. Six- sigma is related to human behavior which differs from situation to situation and from time to time.

CONCLUSIONS

Six sigma is a series of interrelated process to improve quality to than 3.4 defects per million. It is a standard for improving service quality to meet the users' needs. It is an urgent need to bridge the gap between theoretical assumptions and its practical implementation to the academic library. Academic Library is the growing organization which needs to focus on quality of service and user satisfaction. It encourages on continuous improvement and development of the library as well as library staff members. This can be achieved only by applying and experimenting new six-sigma tool and

techniques available today for academic libraries. It will be possible only when librarian must thing innovate and adopt some new management concepts of the library to implement it well. Not only librarian himself but also the members of the staff of the library must be initiative to adopt the new six-sigma concept to improve the standard of the service quality of the library to achieve the ultimate goal of users' satisfaction.

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